

A New Species of *Scymnodalatias* from the Southern Oceans, and Comments on Other Squaliform Sharks

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Abstract *Scymnodalatias albicauda* sp. nov. is described from two specimens taken at high latitudes (45°S and 49°S). It is distinguished from *S. sherwoodi*, only known species of the genus, by having white markings on the caudal fin, the second dorsal posterior tip almost reaching the upper caudal fin, shorter snout and head, smaller eye and larger fins. Relationships of *Scymnodalatias* to the genera *Scymnodon*, *Centroscymnus*, and *Zameus* are discussed, based chiefly on dermal denticle structure. *Scymnodalatias* and *Zameus* uniquely share transverse ridges on their dermal denticles, and on this character they are treated as sister-groups. Comments on the above genera, *Z. squamulosus* and some species of *Scymnodon* are made to clarify their systematic status. As a result, it is proposed that *Scymnodon* includes *ichiharai*, *macracanthus*, *plunketi*, and *ringens*, that *Centroscymnus* includes *coelolepis*, *crepidater*, *cryptacanthus*, and *owstonii*, and that *Zameus* includes *squamulosus*.

The main purpose of this account is to describe a new species of the squaliform genus *Scymnodalatias* from two specimens taken at high latitudes (45°S and 49°S) in the Indian and Pacific oceans. Until now *Scymnodalatias* Garrick, 1956 has been definitely known from only one specimen, the holotype of *Scymnodon sherwoodi* Archev, 1921, a male of 803 mm total length found stranded on the east coast of the South Island, New Zealand. Parin *et al.* (1981) tentatively reported, as *Scymnodalatias* sp., a 410 mm female from the south eastern Pacific, but their account is not sufficiently informative to confirm the generic identification (see Addendum).

The two specimens described here, females of 914 mm and 1074 mm, from depths of about 150–200 m and 572 m, unreservedly belong in *Scymnodalatias*, and as they are in excellent condition they provide a better opportunity for characterising the genus than does the holotype of *sherwoodi* which is in a very poor state of preservation. Differences between the two specimens and the holotype are of sufficient magnitude for us to describe our new species with confidence, even though it is likely that some of the differences may, in part or whole, be attributable to allometry and sexual dimorphism.

The opportunity is also taken to examine further the relationships of *Scymnodalatias* to some other squaliform genera, notably *Scymnodon* Bocage et Capello, 1864 and *Centroscymnus* Bocage et

Capello, 1864, and to provide additional information on poorly known species of these genera with the intention of clarifying their status.

Materials and methods

Specimens used in the present study and detailed below came from the British Museum (Natural History), London—BMNH; Canterbury Museum, Christchurch, New Zealand—CMNZ; Florida State Museum, Gainesville—FSM; Department of Fisheries, University Museum, University of Tokyo—FUMT; Institut für Seefischerei, Hamburg—ISH; Muséum National d'Histoire Naturelle, Paris—MNHN; National Museum of New Zealand, Wellington—NMNZ; and the United States National Museum of Natural History, Washington, D.C.—USNM.

Scymnodalatias albicauda sp. nov. See Study material preceding the description where details are given of the holotype and paratype, the only two specimens known.

Scymnodalatias sherwoodi (Archev, 1921). Holotype, the only known specimen, CMNZ 438, mature male, 803 mm, New Zealand, Canterbury, New Brighton Beach, June 1920, C.W. Sherwood.

Zameus squamulosus (Günther, 1877). USNM 220359, immature male, 256 mm, Gulf of Mexico, Mississippi, 29°7.5'N, 88°4'W, 0–722 m, Oregon Sta. 2824; FSM 35688, immature male, 452 mm, Gulf of Mexico, Alabama, 29°09'N, 87°58'W, Oregon II, Cruise 9, Sta. 10650, 25 June 1969; NMNZ 16156, female, 606 mm, New Zealand, off Banks

Peninsula, $44^{\circ}35.3' - 44^{\circ}34.2'S$, $174^{\circ}05.9' - 174^{\circ}05.0'E$, 880–900 m, James Cook, J/17/26/84, 4 Oct. 1984; BMNH 1880.5.1.1, female, 667 mm (holotype of *Centrophorus squamulosus* Günther, 1877), Japan, Imosiima, Challenger Sta. 232, 631 m; also radiographs of MNHN 84-388, female, 590 mm (holotype of *Centroscymnus obscurus* Vaillant, 1888), Côtes du Soudan, *Talisman*.

Scymnodon ringens Bocage et Capello, 1864. ISH 147/74, juvenile male, 455 mm, North Atlantic, Porcupine Bank SW, $52^{\circ}44'N$, $14^{\circ}46'W$, 655–642–625 m, Walter Herwig Sta. 316/74, 28 May 1974; BMNH 1973.10.29.27–28, juvenile female, 473 mm, North Atlantic, $52^{\circ}06.5' - 52^{\circ}02'N$, $12^{\circ}45' - 12^{\circ}51.5'W$, 768–814 m, Holt Sta. 28, 6 July 1968, A. C. Wheeler; BMNH 1973.10.29.27–28, female, 625 mm, North Atlantic, $52^{\circ}06'N$, $12^{\circ}10' - 12^{\circ}20.5'W$, 576–686 m, Holt Sta. 26, 6 July 1968, A. C. Wheeler; ISH (uncatalogued), female, 990 mm, North Atlantic, $56^{\circ}40'N$, $09^{\circ}07'W$, 820–841 m, Walter Herwig Sta. 337/83, 20 May 1983.

Scymnodon macracanthus (Regan, 1906). BMNH 1884.2.6.7, female, 687 mm (holotype of *Centroscymnus macracanthus* Regan, 1906), Straits of Magellan.

Scymnodon plunketi (Waite, 1910). NMNZ 2637, juvenile female, 523 mm, New Zealand, Kaikoura, Oaro, 914 m, November 1955, R. Baxter; NMNZ 13423, juvenile male, 660 mm, New Zealand, western Challenger Plateau, $40^{\circ}28.8' - 40^{\circ}27.5'S$, $168^{\circ}0.46' - 168^{\circ}0.94'E$, 1011–1004 m, James Cook, J/4/21/83, 19 February 1983.

Centroscymnus crepidater (Bocage et Capello, 1864). NMNZ 2538, embryo male, 252 mm, New Zealand, Kaikoura, 914 m, November 1955, R. Baxter.

Centroscymnus owstonii Garman, 1906. NMNZ 2539, immature female, 584 mm, New Zealand, Kaikoura, 1097 m, September 1956, R. Baxter.

The methods used for taking measurements and for making counts of teeth and vertebrae were as given in Garrick (1982), except that the precaudal vertebral count included all complete centra anterior to the origin of the upper lobe of the caudal fin.

Genus *Scymnodalatias*

Scymnodalatias Garrick, 1956: 564 (type species *Scymnodon sherwoodi* Archey, 1921 by original designation).

Amended generic diagnosis. Squaliform sharks with small brush-shaped dorsal fins completely lacking fin spines, the first dorsal fin placed about halfway along the total length. Tail with a slightly upraised axis, well developed upper and lower lobes, and a distinct subterminal notch. Pectoral fins lanceolate, with pointed anterior (outer) tips.

Teeth one-cusped and dissimilar, the uppers needle-like, the lowers with high, erect, smooth-edged, triangular, blade-like cusps. Dermal denticles pediculate, with flat, blade-like crowns, their posterior margins dentate, their outer surfaces with prominent longitudinal ridges and lesser transverse ridges.

Scymnodalatias albicauda sp. nov.

(Figs. 1, 2, Table 1)

Study material. Holotype: FUMT P-197, female, 914 mm, southern Indian Ocean, $45^{\circ}S$, $92^{\circ}E$, 150–200 m, March 8, 1967, tuna longline vessel No. 35 *Shotoku-maru*. Paratype: NMNZ 9511, female, 1074 mm, southern Pacific Ocean, Pukaki Rise, $49^{\circ}27'S$, $174^{\circ}00'E$, 512 m, November 3, 1979, trawler *Akhellion*.

Description. Proportional dimensions in percentage of total length are shown in Table 1. External body form in Fig. 1.

Head slightly depressed, short-snouted. Head length measured from snout tip to 5th gill-opening about one-fifth of total length. Body stout, relatively long, its length from 5th gill-opening to upper caudal origin three-fifths of total length. Dorsal and ventral profiles smooth and relatively arched. No predorsal or interdorsal ridges on midline of back and no lateral ridges on body. Middorsal and midventral longitudinal grooves on caudal peduncle. Height of trunk at origin of pectorals two-thirds of head length. Caudal peduncle lacking keels and precaudal pits, relatively compressed, its width 1.5 in its height at upper caudal origin.

Dermal denticles small, tightly packed and overlapping so as to conceal the entire skin, and covering the whole body except for the axils of pectoral and pelvic fins. Pectoral and pelvic fins each with a naked axillary area extending along the upper surface of the fin to its inner tip and parallel to its posterior margin. Each denticle (Fig. 2) of the trunk region with a broad, horizontal blade, strongly tridentate posteriorly, sometimes with one additional weak tooth on each side. Surface of each blade with five major longitudinal ridges, including a medial ridge, and two lateral ridges on either side. Medial ridge broad-topped at the basal end of the blade with a shallow, longitudinal groove, but increasingly sharp-topped posteriorly. Lateral ridges sharp-topped, extending to posterior end of the blade, each with

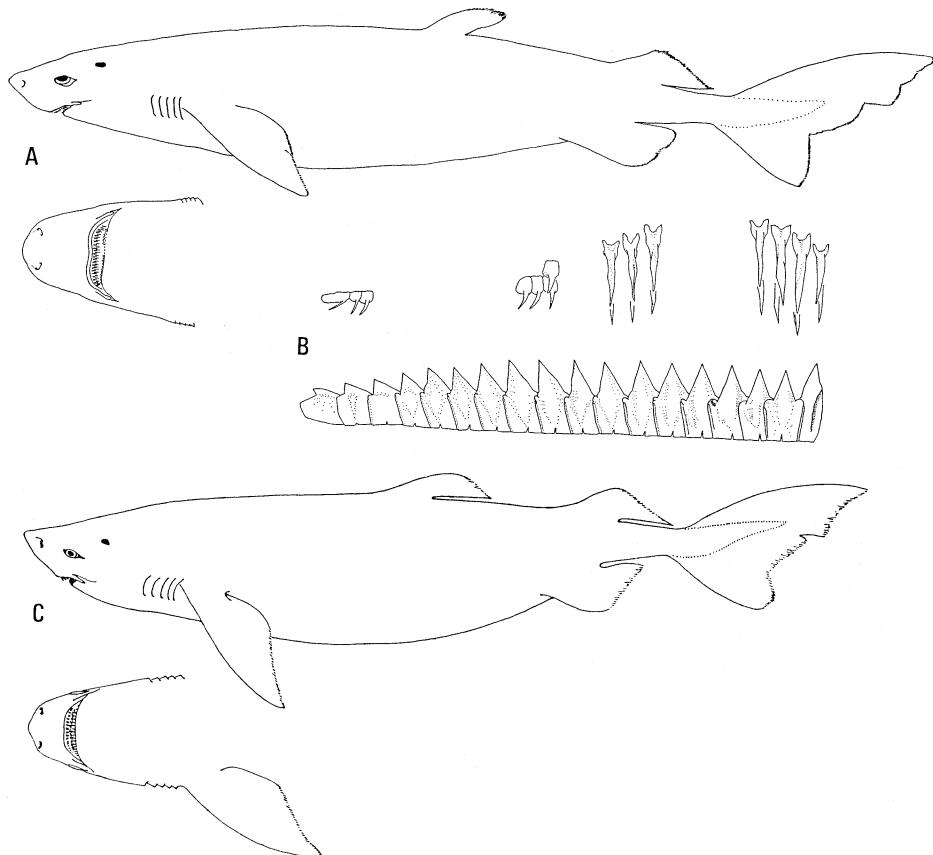


Fig. 1. *Scymnodalatias albicauda* sp. nov. A, holotype, FUMT P-197, female, 914 mm, from the southern Indian Ocean (45°S, 92°E); B, teeth of holotype (right side); C, paratype, NMNZ 9511, female, 1074 mm, from the southern Pacific Ocean.

one and sometimes two minor ridges. Crescent shaped transverse ridges which are less developed than the longitudinal ridges are also present on the outer surface of each blade, particularly at the basal end.

Head compact, and subcircular in transverse section at eyes. Outline of head in lateral view sharply pointed at the snout tip, slightly concave dorsally and strongly convex ventrally; in dorsoventral view moderately pointed, strongly tapered from the nostrils toward the snout tip itself, and slightly concave between eyes and nostrils. Prenarial length one-fourth of preoral length. Eye opening with weak anterior and strong posterior notches, its length twice its height and 7 in head length. Spiracle large, its length 2.0 in horizontal diameter of eye opening, and located one eye length behind eye. Gill openings vertical, concave and arranged in a horizontal series an-

terior to the pectoral base; the lengths nearly equal, slightly smaller than eye opening. Interspace between gill-openings subequal. Nostrils small, oblique, oval in shape, one-fourth as long as eye openings, their inner ends much nearer to snout tip than to mouth. Interspace between nostrils 2 in preocular length. Each nasal aperture subdivided into a circular anterior aperture and an elongate posterior aperture by triangular anterior and rectangular posterior nasal flaps. Mouth broad and slightly arched, its length 4 in its width. Mouth width a little more than preoral length and 2.1 in head length. Upper lip fimbriated, with dark cross folds, but lower lip smooth with a broad naked margin. A subcircular lobe on the symphysial membrane of lower jaw.

Teeth $\frac{29-28}{17-1-17}$ in the holotype and $\frac{31-31}{17-1-17}$ in the paratype, dissimilar in the two jaws. Upper teeth each with a single, smooth-edged, lanceolate

Table 1. Proportional dimensions in percentage of total

Species	<i>Scymnodalatias</i>			<i>Zameus</i>	
	<i>albicauda</i>		<i>sherwoodi</i>	USNM 220359	FSM 35688
Catalog number	FUMT P-197*	NMNZ 9511**	CMNZ 438*		
Sex	female	female	male	male	male
Total length (mm)	914	1074	803	256	452
Snout tip to: outer nostrils	1.5	1.2	2.4	2.1	1.6
eye	4.6	4.5	6.2	6.6	4.9
mouth	4.9	3.9	8.0	9.6	8.4
spiracle	9.5	9.0	11.7	13.9	12.2
1st gill-opening	14.9	14.0	19.0	20.5	17.1
3rd gill-opening	16.9	16.0	20.8	22.9	18.8
5th gill-opening	18.9	17.8	22.4	24.4	20.5
pectoral origin	18.9	18.0	22.4	24.8	20.7
pelvic origin	57.4	60.9	62.4	56.1	58.8
1st dorsal origin	44.0	41.0	44.7	38.7	38.1
2nd dorsal origin	64.4	62.7	66.4	58.6	62.6
upper caudal origin	77.1	76.7	80.6	75.0	78.5
lower caudal origin	75.1	75.3	78.9	73.8	77.0
Nostrils: distance between inner corners	3.3	3.4	4.3	5.5	4.0
Mouth: width length	8.8	7.8	9.0	8.8	7.5
Labial furrow lengths: upper	2.2	2.3	2.0	3.5	2.8
lower	1.2	1.0	0.7	2.7	1.4
Gill-opening lengths: 1st	2.3	2.4	2.2	1.4	1.8
3rd	2.5	2.6	—	1.6	1.5
5th	2.6	2.9	2.4	2.0	2.1
Eye: horizontal diameter	2.7	2.6	4.0	5.5	4.9
1st dorsal fin: length of base	5.9	6.9	5.0	6.6	5.8
length of post. margin	4.8	7.1	3.2	5.3	4.1
height	3.5	2.9	2.4	2.9	2.2
2nd dorsal fin: length of base	5.8	7.6	6.2	7.6	7.5
length of post. margin	6.3	6.5	3.5	5.5	4.4
height	4.2	4.0	2.8	3.5	2.8
Pectoral fin: length of base	4.7	5.6	5.8	6.3	7.1
length of ant. margin	17.2	18.6	10.6	11.7	12.2
length of distal margin	9.6	9.0	5.0	—	—
greatest width	—	7.0	4.0	5.9	5.5
Pelvic fin: length of base	9.1	7.8	6.2	5.3	6.2
length of ant. margin	10.3	9.0	5.7	6.4	5.8
length of distal margin	6.2	7.3	5.2	—	—
length of clasper	—	—	5.1	2.7	4.0
Caudal fin: length of upper lobe	24.6	24.7	19.1	24.2	21.0
length of lower lobe	12.2	13.5	10.6	12.9	12.2
Trunk at pectoral origin: width	13.1	13.5	13.0	12.5	11.3
height	12.0	13.4	14.0	9.4	9.5
Dental formula:	29-28 17-1-17	31-31 17-1-17	28-1-28 16-1-17	30-30 19-19	—
Vertebrae: precaudal	57	59	58	—	—
caudal	25	24	23	—	—
total	82	83	81	—	—
monospondylous	43	44	45	—	—

* Holotype; ** Paratype.

Taniuchi and Garrick: New Species of *Scymnodalatias*

length of species of *Scymnodalatias*, *Zameus*, and *Scymnodon*.

<i>squamulosu</i>		<i>Scymnodon</i>						
		<i>ringens</i>			<i>macracanthus</i>		<i>plunketi</i>	
NMNZ 16156	BMNH 1880 5.1.1.*	ISH 147/74	BMNH 1973 10.29.27-28	BMNH 1973 10.29.27-28	BMNH 1884 2.6.7*	NMNZ 2637	NMNZ 13423	
female	female	male	female	female	female	female	male	
606	667	455	473	625	687	523	660	
2.1	1.7	1.0	1.4	1.0	1.3	0.8	1.3	
5.0	4.6	4.2	4.9	4.0	4.2	4.2	3.8	
9.1	7.2	6.0	7.0	5.9	7.9	7.5	7.6	
11.4	10.8	11.2	12.7	10.9	11.6	11.1	11.2	
17.2	16.9	19.3	18.6	17.8	17.3	15.9	16.5	
19.1	—	21.9	—	—	19.5	—	18.0	
21.2	21.0	23.5	22.2	21.4	21.1	18.9	19.2	
21.9	21.7	24.4	23.5	22.4	21.4	19.0	19.2	
58.6	58.5	57.4	60.0	58.4	54.9	54.5	56.8	
40.4	35.5	35.4	35.3	35.0	31.3	33.8	34.1	
63.0	63.3	60.0	62.4	61.3	59.0	58.5	59.8	
78.9	81.3	76.5	77.8	76.8	76.4	76.5	77.9	
76.7	79.0	74.3	74.4	73.3	73.5	73.2	74.8	
4.2	3.0	3.3	3.6	3.2	4.2	3.8	3.8	
7.7	7.0	11.4	11.0	9.9	9.0	6.7	8.2	
2.0	1.8	3.3	3.4	3.7	1.5	1.2	1.5	
3.0	2.7	4.0	3.8	3.8	2.8	2.9	2.7	
2.0	1.5	3.1	2.7	2.7	2.2	2.1	2.0	
1.7	1.3	2.6	3.0	2.9	1.3	1.5	1.8	
1.7	1.3	2.6	3.2	2.9	1.3	1.4	1.8	
1.8	1.5	2.6	2.7	2.5	1.5	1.3	1.7	
4.2	4.0	5.1	5.5	4.8	5.2	5.2	4.5	
6.8	8.4	7.5	9.9	9.0	9.5	6.9	7.4	
5.3	4.3	4.4	4.9	5.0	6.0	5.0	5.0	
2.4	2.4	3.1	4.0	3.8	3.5	3.1	3.4	
9.1	8.5	10.3	11.0	9.4	9.5	7.8	10.2	
4.8	4.8	4.3	5.1	4.8	6.6	5.2	5.3	
3.5	3.4	4.9	7.4	6.2	4.9	4.2	3.9	
6.4	5.8	6.5	7.4	7.5	7.7	9.0	8.3	
12.2	10.5	13.8	13.7	14.2	16.0	15.0	13.8	
—	—	—	—	—	7.9	7.1	—	
5.0	5.5	6.8	7.4	6.9	9.2	8.4	8.3	
8.3	7.8	7.7	8.9	8.5	7.9	6.7	6.1	
8.1	—	9.5	—	—	7.9	6.3	6.8	
5.4	—	5.7	—	—	6.6	—	—	
—	—	2.7	—	—	—	—	2.6	
21.0	19.6	22.4	22.8	22.9	24.5	23.8	22.7	
13.5	12.7	12.1	12.5	12.0	15.3	14.6	13.2	
12.2	12.0	15.4	15.9	14.4	14.8	12.2	13.6	
8.6	10.2	11.9	10.8	9.8	11.1	9.7	8.9	
—	—	24-1-25 14-1-14	—	—	—	—	—	
73	71	78	—	—	85	87	86	
29	30	33	—	—	27	32	32	
102	101	111	—	—	112	119	118	
52	50	58	—	—	66	63	65	

cusp borne on a subtriangular bifid base and arranged in diagonal files with three rows functional, their tips curved inwardly. Starting from the symphysis, 1st tooth smaller than 2nd through 14th teeth which are the longest in the upper jaw; 15th through 28th become increasingly smaller, and more oblique. Each lower tooth with a single, smooth-edged, sharply pointed, blade-like cusp borne on a quadrate base higher than wide, and with one row functional. Cusps erect, at least for the teeth in median half of each side of lower jaw, but increasingly oblique toward corner of mouth. Each lower tooth, from median tooth laterally, overlapping its adjacent tooth.

1st dorsal small, brush-shaped, lacking a spine and originating posterior to the tip of appressed pectoral by a distance equal to about half the pectoral fin length. Base of first dorsal short, 3 in head length; height of first dorsal 1.2 in its base. Anterior and distal margins slightly convex, apex broadly rounded, posterior margin weakly convex, and posterior tip slightly pointed. Second dorsal lacking a spine, higher than 1st, triangular and with a more acute apex. Origin of 2nd dorsal above middle of pelvic base. Second dorsal base equal to that of 1st dorsal. Posterior free tip sharply pointed and terminating just anterior to upper caudal origin. Caudal measured from upper caudal origin 4 in total length. Upper and lower lobes well developed, and axis moderately raised. Upper lobe smoothly convex, and terminal margin concave so that apex is acutely angled and sharply pointed. The lower lobe, 2 in upper, triangular in shape. Subterminal notch well developed. Pectorals originating just anterior to 5th gill-openings, less than half the distance from snout tip to 1st dorsal origin. Pectorals large, length of their anterior margins approximately equal to head length. Anterior and posterior margins slightly convex, distal margin straight, apex acutely angled, and inner corner bluntly angled with broadly rounded tip. Pelvics originating well anterior to 2nd dorsal fin. Pelvics large, their bases 1.5 times longer than dorsal fin bases. Anterior and distal margins slightly convex, outer corner obtuse and smoothly rounded.

Color. Dark brown above, brownish grey below except for a dark brown longitudinal band, about one-third the width of the abdomen, along the middle of the ventral surface. Whitish along

the caudal peduncle and caudal fin, from posterior end of pelvic fin through to at least half of caudal axis, but extending further posteriorly on the upper caudal lobe than on the lower caudal lobe. Dorsal, pelvic, and caudal fins margined with whitish grey.

Etymology. A combination of the Latin names "albus" white and "cauda" tail refers to the white markings on the caudal fin. It should be treated as a noun in apposition.

Differences between *S. albicauda* sp. nov. and *S. sherwoodi*. Most of the differences between these two species are in proportional dimensions and are evident in Table 1, where it can be seen that *S. albicauda* has relatively shorter snout and head proportions, a smaller eye, and larger dorsal fins, pectoral fins, and caudal fin. In estimating the importance of these morphometric differences we are aware that some of them, at least, could be interpreted as products of allometric growth, sexual dimorphism or individual variation. We are also cautious in taking for granted the accuracy of the proportions of the holotype of *sherwoodi*, because that specimen is now in such poor condition that accurate measurements are not possible. The data we use for *sherwoodi* are from Garrick (1956), based largely on a plaster cast in the Canterbury Museum, and agreeing well with Archey's (1921) illustration of the holotype. However, we do not know if that illustration was prepared from the holotype itself or from the plaster cast.

The relatively small size difference between the holotype of *sherwoodi* (803 mm TL) and the two specimens of *albicauda* (914 mm and 1074 mm) suggests that differences in proportions between them due to allometric growth should be minimal. This gives us confidence in interpreting the shorter snout and head proportions, and the smaller eye of *albicauda* as meaningful, even though the trend in squaliforms is for these proportions to decrease relatively with growth (Garrick, 1960b), and the two specimens of *albicauda* themselves appear to follow that trend.

We place more significance in the fact that *albicauda* has larger dorsal fins, pectoral fins and caudal fin, because not only are most of these differences from *sherwoodi* considerable (see Table 1, and in particular the differences between the lengths of the posterior margins of the dorsal fins, the anterior margins of the pectoral fins, and

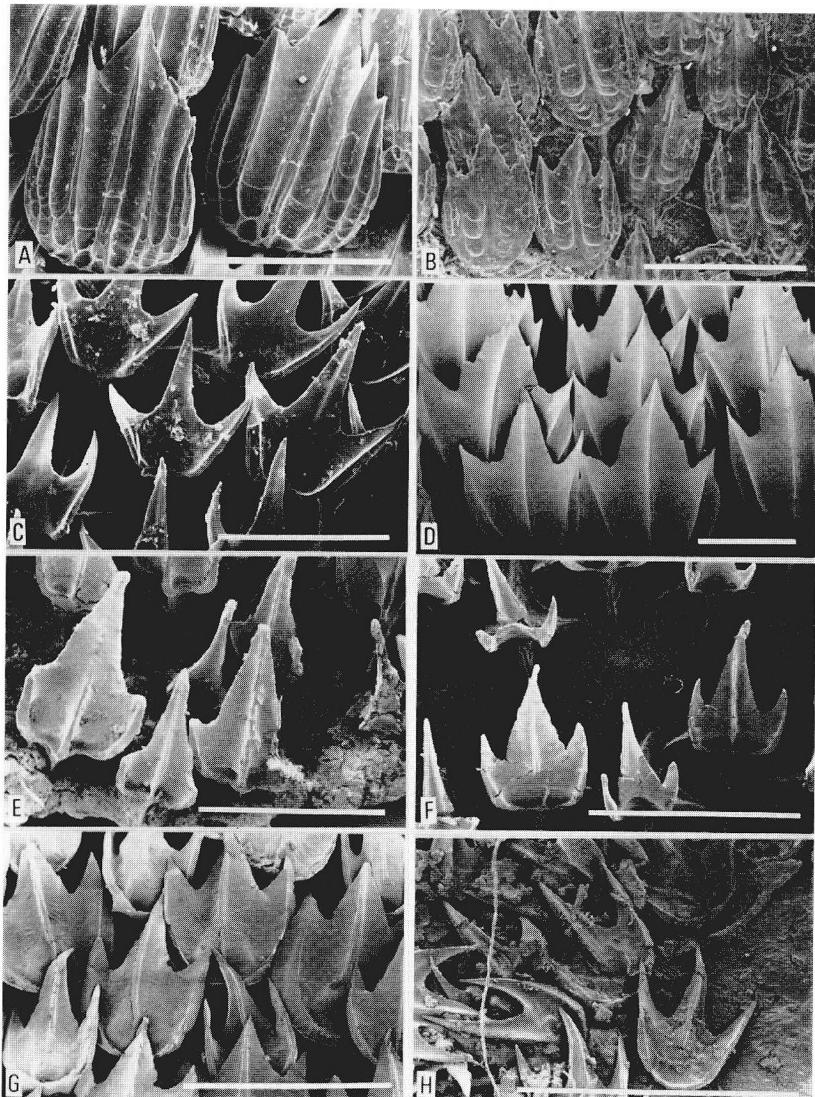


Fig. 2. Dermal denticles from side of anterior part of trunk. Each scale indicates 1 mm. A, *Scymnodalatias albicauda* sp. nov., paratype, NMNH 9511; B, *Scymnodalatias sherwoodi*, holotype, CMNZ 438; C, *Scymnodon ringens*, BMNH 1973.10.29.27-28, juvenile female 473 mm; D, *S. ringens*, ISH (uncatalogued), female, 990 mm; E, *S. macracanthus*, holotype, BMNH 1884.2.6.7, female, 687 mm; F, *S. plunketi*, NMNZ 13423, male, 660 mm; G, *Centroscymnus owstonii*, NMNZ 2539, female, 584 mm; H, *C. crepidater*, NMNZ 2538, embryo male, 252 mm.

the upper lobe of the caudal fin), but in some cases, as for example the length of the caudal fin, the difference is the opposite to what might be expected from change with growth.

We hesitate to use differences in the length of the abdominal region (measured from pectoral axil to pelvic axil this is 42.9% and 45.1% TL in the holotype and paratype of *albicauda* but only

40.4% in *sherwoodi*) as a species distinction, since this may only be a reflection of sexual dimorphism (Hubbs *et al.*, 1967). The same explanation may apply to the longer pelvic bases in the two female *albicauda* than in the male *sherwoodi*. Likewise we believe it is possible that the asymmetrical, twisted upper tooth cusps of the male holotype of *sherwoodi* compared with the symmetrical

straight cusps of *albicauda* may also be an expression of sexual dimorphism analogous to that known in some other genera of squaliform sharks and particularly *Deania* (Garrick, 1960a).

There are two other notable differences between *albicauda* and *sherwoodi* which do not appear to be a product of either sexual dimorphism or allometry. Firstly, there is a difference in colour with *albicauda* having obvious white markings on the caudal fin which are seemingly lacking in *sherwoodi*. Archey (1921) gave a detailed description of the colour of *sherwoodi* but did not mention white markings on the tail though he noted "two submedian light areas extending from below the gill-openings to the ventrals" as is also the case in *albicauda*, white markings on the gill-openings and pectoral margins, and a "median dorsal silvery blaze" from the spiracle to the level of the pectoral axil which he believed to be "possibly not a natural condition". Secondly, in *albicauda* the second dorsal posterior tip reaches almost to the upper caudal fin origin, whereas in *sherwoodi* it falls short by a distance somewhat greater than the length of the posterior tip.

Finally, we record that although the descriptions and figures of the dermal denticles of *sherwoodi* by Archey (1921) and Garrick (1956) give no indication of transverse ridges such as are present in *albicauda*, this is not a difference between the species. Recent examination of *sherwoodi* denticles shows that transverse ridges are present (Fig. 2).

Discussion

Relationship of *Scymnodalatias* to other genera. Although Garrick (1956) treated his new genus *Scymnodalatias* as a member of the Dalatiidae because of its total lack of fin spines and the slightly posterior position of its first dorsal fin, that placement did not receive general acceptance. Fin spines appear to have been lost independently in more than one squaliform lineage (Hubbs and McHugh, 1951; Maisey, 1975), and hence their absence is not necessarily indicative of dalatiids. Moreover, Compagno's (1973) extensive studies led him to merge, at least provisionally, all squaliform genera except *Echinorhinus* into a single family Squalidae, and later (1984a) to separate *Scymnodalatias* from other dalatiine genera and to recognise it as "very close to the genus *Scymnodon*" in which its type species,

sherwoodi, was originally placed. We agree with these tentative findings, and offer further evidence below for a close relationship between *Scymnodalatias* and the species currently recognised as *Scymnodon squamulosus*, *S. obscurus*, and *S. niger* Chu et Meng, 1982.

The character on which we place most weight is the presence of transverse ridges on the outer surface of the dermal denticle blades. (In describing the morphology and sculpture of dermal denticle blades we restrict ourselves to those denticles on the sides of the anterior part of the trunk. Denticles from other regions, and notably the head, are frequently different from trunk denticles.) These transverse ridges are much less well developed than the longitudinal ridges, and can be regarded as a form of microsculpture. They were first recorded by Vaillant (1888) in the original description of *S. obscurus*, but were not documented in other nominal species until reported by Chu et al. (1982) in their new species, *S. niger* and Yano and Tanaka (1984) in the holotype of *S. squamulosus*. Our present description of them from both species of *Scymnodalatias* is the only other occurrence that we are aware of in squaliforms.

The uniqueness of the transverse ridge microsculpture leads us to believe that it is a significant derived character, of sufficient importance to indicate close relationship between *Scymnodalatias* and the three species of *Scymnodon* which possess it. Since the latter three species seem, in fact, to be synonyms (see Yano and Tanaka, 1984; Compagno, 1984a, and evidence below), they can for the purpose of this discussion be treated jointly under the oldest name of the trio, *Centrophorus squamulosus* Günther, 1877, which in turn is the type-species of *Zameus* Jordan et Fowler, 1903. Although there are similarities between *Scymnodalatias* and *Zameus* in many aspects of their morphology, including their teeth, there are also important differences, the most noteworthy being the complete absence of dorsal fin spines, and the lanceolate pointed pectoral fins in *Scymnodalatias*. These differences warrant generic distinction, and accordingly we propose the retention of the name *Scymnodalatias* for *sherwoodi* and *albicauda* and the use of the neglected name *Zameus* for *squamulosus*. This latter proposal was also recently suggested by Compagno (1984a) though not for the same reasons.

Compagno's suggestion had the main purpose of highlighting the difference between *squamulosus* and *S. ringens* Bocage et Capello, 1864, the type species of *Scymnodon*. It is obvious from our findings that *Zameus squamulosus* must be generically distinct from *Scymnodon ringens*, but we cannot postulate further than that on the relationship between either of these two genera or between *Scymnodon* and *Scymnodalatias*. Our only firm conclusion on generic relationships (as opposed to generic differences) is that *Zameus* and *Scymnodalatias* have a sister-group relationship based on their dermal denticle microsculpture.

Comments on *Scymnodon* and *Centroscymnus*.

Removal of *squamulosus* (and along with it *obscurus* and *niger*) from *Scymnodon* leads us to consider the remaining membership of and the generic criteria for *Scymnodon*. Such consideration, however, is not rational unless it also includes *Centroscymnus* Bocage et Capello, 1864, because not only are there many similarities between the species assigned to these two genera, but as well there have been longstanding differences between authors (see Compagno, 1984a) as to whether particular species, notably *Centrophorus plunketi* Waite, 1910, should be assigned to *Scymnodon* or to *Centroscymnus*. These differences, in essence, stem from divergent views on the relative importance of lower tooth shape versus dermal denticle morphology as primary generic criteria. A third criterion stated by Bigelow and Schroeder (1957), in which the length of the upper teeth at the center of the mouth is compared with the length of those midway along each side of jaw (the former much shorter than the latter in *Scymnodon*, but only slightly shorter in *Centroscymnus*) has been listed in the accounts of many subsequent authors, but its overall value is yet to be assessed and we do not deal with it here.

Compagno (1984a) notes that the separation of *Scymnodon* from *Centroscymnus* "is unsatisfactory with criteria in current usage" and elects to separate them on the shape of the lower teeth ("relatively high, more or less erect cusps" in *Scymnodon*, "relatively low, more or less oblique cusps" in *Centroscymnus*) even though there is a "Centroscymnus-*Scymnodon* continuum" in their teeth. The consequences of that decision are that Compagno includes in *Centroscymnus* not only

those species (*coelolepis*, *owstonii*, *crepidater*, and *cryptacanthus*) which have dermal denticles with a circular concavity at the anterior end of the blade but also other species (*plunketi* and *macracanthus*) in which there is no circular concavity on the denticles but instead, at least in sub-adult and adult denticles, a median longitudinal ridge occupying the whole length of the denticle. This latter type of denticle is also found in *S. ringens*, the type-species of *Scymnodon*, whereas the denticles with a circular concavity are characteristic of *C. coelolepis*, type-species of *Centroscymnus*. Complicating the issue is the fact that there is change in the shape and sculpture of successive generations of replacement denticles within each of the species. This is most marked in species such as *coelolepis* where juvenile tridentate denticles with at least a partial longitudinal ridge are replaced by denticles in which the ridging and posterior dentations are increasingly reduced, so that adult denticles are ridgeless with smoothly rounded crowns. Denticles of *owstonii* and *crepidater* follow almost the same changes except that adult denticles frequently retain reduced posterior ridges and dentations, particularly in *crepidater*. Such ridged, tridentate adult denticles are superficially similar to the adult denticles of *plunketi* and *macracanthus*, and for that matter, of *Scymnodon ringens*, the main difference being that they have a circular concavity anteriorly rather than a complete longitudinal ridge. Likewise the tridentate juvenile denticles of *coelolepis*, *owstonii* and *crepidater* are clearly similar in basic shape to those of *plunketi*, *macracanthus* and *ringens*. Seemingly it is because of these similarities that the denticles have been regarded by Bigelow and Schroeder (1957) and Compagno (1984a) as of less importance than the lower teeth for separating *Centroscymnus* from *Scymnodon*.

The above facts on denticle shape and sculpture in *Centroscymnus* and *Scymnodon* have long been known for most of the species and are now well documented (e.g. Bigelow and Schroeder, 1957; Garrick, 1959b, c; Cadenat and Blache, 1981; Yano and Tanaka, 1984). However, in our re-examination of these data we have come to the conclusion that the denticles still offer firmer ground for distinguishing the genera than do the lower teeth, especially if the characteristics of the earliest ontogenetic stages, i.e. the first generation of denticles, are closely scrutinised.

We find that the first generation of denticles of *S. ringens* are tridentate in shape but completely lack any median longitudinal ridge (Fig. 2). Exactly the same is true for juvenile denticles of *plunketi* as illustrated in Garrick (1955 as *waitei*, 1959c). Similarly Yano and Tanaka's (1984) account of *ichiharai*, a new species very similar to *plunketi*, includes a SEM photograph (fig. 6A) showing the same tridentate, ridgeless denticles. Lastly an examination of the holotype and only known specimen of *macracanthus*, a sub-adult of 687 mm TL, indicates that although most of its denticles are presumably a replacement sub-adult generation with ridged, tridentate denticles, there are still a few smaller juvenile denticles remaining, and these are ridgeless (Fig. 2) like those of *ringens*, *plunketi*, and *ichiharai*.

Compared with the above, the juvenile denticles of *coelolepis*, type-species of *Centroscymnus*, are similarly tridentate in outline but differ in having an incomplete median ridge along the posterior part of the blade (see Bigelow and Schroeder, 1953: fig. 5, as *S. melas*). Likewise, incompletely ridged denticles first appear in juveniles of *owstonii* (Fig. 2, and Garrick, 1959b) and *crepidater* (Fig. 2, and Garrick, 1959b; Cadenat and Blache, 1981). We have no data for *cryptacanthus*.

In an attempt to gauge the significance of the above two types of juvenile denticles we briefly surveyed members of other squaliform genera, restricting our search to those with blade-like crowns on their denticles. Amongst the taxa surveyed (*Squalus*, *Deania*, *Oxynotus*, *Zameus*, and *Centrophorus squamosus*), using as sources Garrick (1959a, 1960a, b) and Cadenat and Blache (1981), we found complete consistency, with all juvenile denticles having median longitudinal ridges extending the whole length of the denticle blades. This means that the situation in *Scymnodon*-*Centroscymnus* where ridging is either lacking or incomplete is, at least, unusual, and could be interpreted as apomorphic if the broad-based squaliform outgroup comparison we made is meaningful. Further support for this view is provided by our observation that fully ridged juvenile denticles are very widespread amongst other sharks, including even members of such disparate orders as the Hexanchiformes on the one hand, and the Lamniformes and Carcharhiniformes on the other.

Despite the above general conclusion that juvenile denticles of *Scymnodon* and *Centroscymnus* are apomorphic relative to those of some other squaliforms, we are not convinced that they both belong to the same transformation series. The evidence for this comes from their subsequent ontogenies, i.e. the successive generations of replacement denticles which appear in sub-adults and adults. In the species with "Scymnodon" denticles (*ringens*, *plunketi*, *ichiharai*, and *macracanthus*) the ridgeless juvenile denticles are replaced by denticles which are fully ridged (e.g. Fig. 2, and Garrick, 1959c). By contrast, in the species with "Centroscymnus" denticles (*coelolepis*, *owstonii*, *cryptacanthus*, *crepidater*) the partly ridged juvenile denticles are replaced by denticles in which the ridging is progressively reduced. The reduction varies amongst the species, being least marked in *crepidater* (Garrick, 1959b) and most extensive in *coelolepis* where adult denticles completely lack ridges (Yano and Tanaka, 1983).

The above-mentioned differences in the dermal denticles offer an unequivocal basis for referring species to either *Scymnodon* or *Centroscymnus*, regardless of what growth stage is examined. Use of lower tooth shape as generic criteria, as in Compagno (1984a), is by contrast much more subjective, with no clear limits for either genus. A crude quantification of the values for cusp height relative to root height in seven of the species, based on measurements from illustrations in Bigelow and Schroeder (1948, 1953, 1957), Garrick (1959b, c) and Yano and Tanaka (1984), plus our observations of the holotype of *macracanthus* yields values as follows (except for *crepidater* and *coelolepis* where values from two specimens were available, all other values are for one specimen only, and are expressed as cusp height as % of root height in the central lower teeth): *ringens*, 124; *crepidater*, 50-74; *ichiharai*, 54; *plunketi*, 37; *owstonii*, 31; *macracanthus*, 25; *coelolepis*, 14-16.

It is obvious that the extreme values pertain for the type-species of both genera—124% for *Scymnodon ringens* and 14-16% for *Centroscymnus coelolepis*. Within that wide range there is no clear cut demarcation point, unless it is accepted that *Scymnodon* includes only the one species, *ringens* (124%), and *Centroscymnus* contains all the others (14-74%). Such a demarcation would agree with Compagno's composition of the genera. Alternatively if the species are assigned

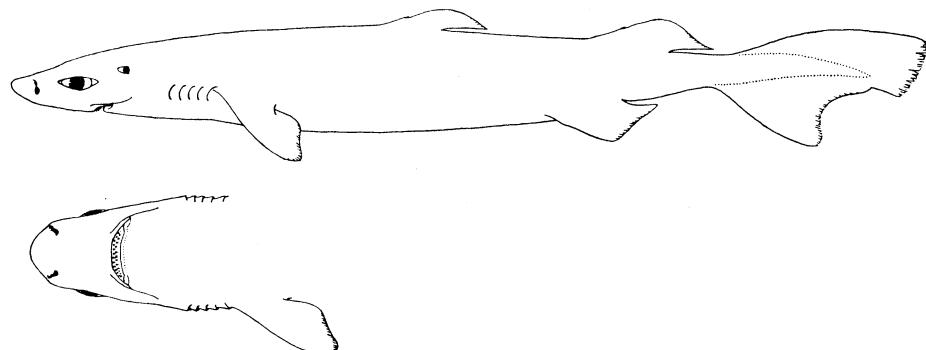
to the genera according to their dermal denticle structure, then the values for *Scymnodon* range from 24 to 124, and those for *Centroscymnus* from 14 to 74. Thus under either scheme there is considerable variation within a genus. These differing values are a reflection of a kind of transformation that must have occurred independently in many shark lineages. We refer here to a change from erect cusps to oblique cusps since that is what the values predominantly represent. Functional considerations suggest that erect cusps with cutting edges on both their medial and lateral margins are plesiomorphic. Transformation of such double-edged erect cusps to oblique cusps would then explain why the oblique cusps still retain cutting edges on their lateral margins even though these are essentially non-functional. We see this as a more parsimonious explanation of these lateral cutting edges than if the transformation had been in the opposite direction. If this explanation is correct, then *S. ringens* is the most plesiomorphic of the species in terms of its lower tooth shape, and the others show varying degrees of apomorphy. The extent of this apomorphic variation is rather more than is found in other squaliform genera such as *Squalus* or *Centrophorus* where lower tooth shape, or degree of obliqueness of the cusps, is much more consistent. We cannot interpret the significance of these differences between genera, but we note that in some species, as for example *Deania calcea*, there can be considerable variation in this feature attributable to sexual dimorphism alone.

On the basis of the above discussion we propose that *Scymnodon* includes *ringens*, *ichiharai*, *macracanthus* and *plunketi*, and that *Centroscymnus* includes *coelolepis*, *crepidater*, *cryptacanthus* and *owstonii*.

Comments on *Zameus squamulosus*. Yano and Tanaka (1984) formally recognised *Centroscymnus obscurus* Vaillant, 1888 as a junior synonym of *Scymnodon squamulosus* (Günther, 1877), based on their comparison of proportional dimensions of Atlantic specimens (including the holotype of *obscurus*) and Japanese specimens, and their finding that the holotype of the Japanese *squamulosus* has dermal denticles with transverse ridges as in *obscurus*. They also, by inference, included *Scymnodon niger* from the South China Sea as another synonym, in their discussion of the distribution of *squamulosus*. Compagno

(1984a) tentatively reached the same conclusions, but through not being able to examine the holotype of *squamulosus* could not confirm them. However, in an addendum to the same study Compagno (1984b: 564) supported Yano and Tanaka's (1984) action in synonymising *squamulosus* and *obscurus*. We agree with these findings, although as concluded above, we place *squamulosus* in *Zameus* rather than *Scymnodon*. The findings are supported by a relatively large amount of recent data in the form of proportional dimensions, meristics of vertebrae and teeth, and descriptions and illustrations from the following accounts: Bass *et al.*, 1976 as ? *obscurus* from off Durban, South Africa; Krefft, 1980, as *obscurus* from the tropical and south Atlantic; Cadenat and Blache, 1981, as *obscurus* from the eastern Atlantic, including proportional dimensions of the holotype; Nakaya, 1982, as *obscurus* from the Kyushu-Palau Ridge, south of Japan; Chu and Meng in Chu *et al.*, 1982, as *Scymnodon niger* from the South China Sea; Shirai, 1983, as *squamulosus* (though the denticles are described as lacking transverse ridges) from Japan, south of northern Honshu; Uyeno and Sasaki, 1983, as *obscurus* from off Suriname and French Guiana; Nakaya, 1984, as *squamulosus* from the Okinawa Trough and adjacent regions; Yano and Tanaka, 1984, as *squamulosus* from Japan (off Suruga Bay), Suriname, and Western Australia; and Compagno (1984a) as *obscurus* and *squamulosus* in an annotated and illustrated catalogue. Proportional dimensions of *squamulosus*, especially those in the more extensive listings given in Krefft (1980—three Atlantic specimens), Cadenat and Blache (1981—seven Atlantic specimens including the holotype of *obscurus*) and Yano and Tanaka (1984—four Japanese, eight Atlantic including the holotype of *obscurus*, and one Western Australian specimen) are now well documented, a situation in marked contrast to that reported by Krefft (1980) who noted that at that time *obscurus* had not been described again since Vaillant's (1888) original account. We further extend these data by providing proportional dimensions (Table 1) of specimens from additional areas (Gulf of Mexico—two specimens, New Zealand—one specimen) plus those of the holotype of *squamulosus*, and give illustrations (Fig. 3) of one specimen from New Zealand.

Using the above sources of information we find

Fig. 3. *Zameus squamulosus*, NMNZ 16156, female, 606 mm, from off Banks Peninsula, New Zealand.

that we cannot confirm the distinction of *S. niger*, and hence relegate it to the synonymy of *squamulosus*. We suspect that its authors had inadequate literature for comparison, perhaps only the original type description, as this would explain, for example, their characterising *obscurus* as having a snout length longer than the eye. Vaillant's (1888) illustration of the holotype shows a very small eye relative to the snout, but that is incorrect judging by Cadenat and Blache's (1981) and Yano and Tanaka's (1984) data from the holotype in which the eye is only slightly shorter. Other cited differences can be encompassed by variation in proportions due to allometric growth or individual variation.

Vertebral numbers in *squamulosus* (Table 2) do not show geographical variability, though the

samples are admittedly very small. Yano and Tanaka's (1984) data from four Japanese specimens cover the variation in virtually all other samples.

Comments on some species of *Scymnodon*. *Scymnodon ringens*: Relatively few firm descriptive data are available for the eastern Atlantic *ringens*, and so we take this opportunity to present proportional dimensions of three juvenile specimens (Table 1), illustrations of one (Fig. 4), and SEM photographs of the dermal denticles of a juvenile and an adult (Fig. 2). Maurin and Bonnet (1970) gave proportional dimensions of one specimen, and Yano and Tanaka (1984) of two. Illustrations were given in Bigelow and Schroeder (1957), Maurin and Bonnet (1970), Cadenat and Blache (1981), and Compagno (1984a).

Table 2. Vertebral numbers in *Zameus squamulosus*.

Source		Precaudal	Caudal	Total	Mono-spondylous
Bass <i>et al.</i> (1976)	off Durban, South Africa	66, 69, 73	—	—	—
Yano and Tanaka (1984)	Japan, off Suruga Bay	67, 69, 73, 76	—	93, 98, 103, 105	54, 50, 51, 53
SU 26784 (Compagno, pers. comm.)	Japan	71	29	100	51
BMNH 1880-5-1-1* (Holotype)	Japan, Imosima	71	30	101	50
ISH 511/68 (from Krefft, 1980)	off tropical West Africa	72	28	100	52
Yano and Tanaka (1984)	Suriname	72-75	—	97-102	51-53
NMNZ 16156	New Zealand	73	29	102	52
ISH 1488/68, 823/71 (from Krefft, 1980)	central South Atlantic	74, 74	26, 26	100, 100	53, 53
MNHN 84-388** (Holotype of <i>C. obscurus</i>)	“Côtes du Soudan”	75	27	102	52

* Holotype of *Centrophorus squamulosus* Günther, 1877.** Holotype of *Centroscymnus obscurus* Vaillant, 1888.

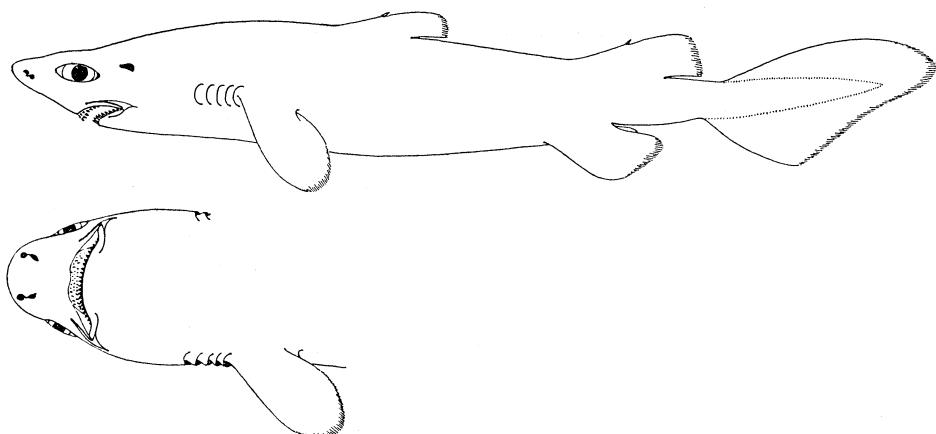


Fig. 4. *Scymnodon ringens*, ISH 147/74, juvenile male, 455 mm, from Porcupine Bank SW, North Atlantic.

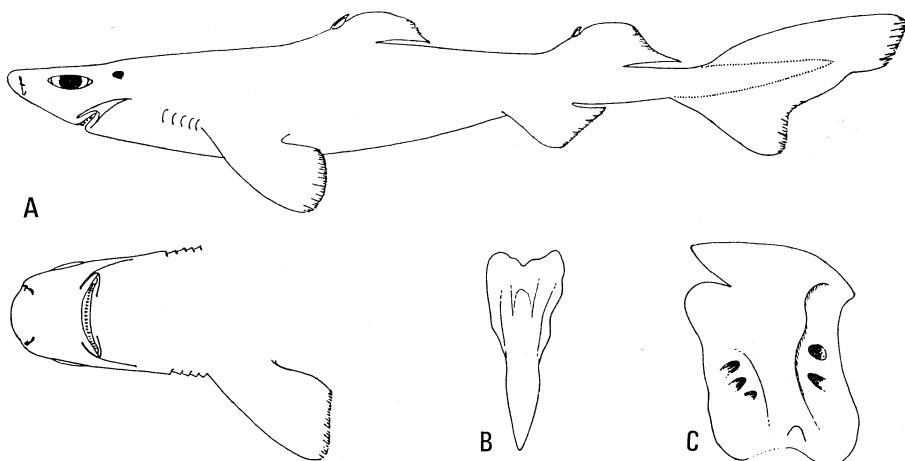


Fig. 5. *Scymnodon macracanthus*. A, holotype, BMNH 1884.2.6.7, 687 mm, from Straits of Magellan; B, 4th upper tooth (right); C, 6th lower tooth (right).

Scymnodon macracanthus: This species is still known only from the holotype, a juvenile female of 687 mm from the Straits of Magellan. Compagno (1984a) tentatively treated *Etomopterus paessleri* Lönnberg, 1907 from the same area as a junior synonym of *macracanthus*, but noted that the three syntypes of that species have apparently been lost. Because there is very little detailed information on the holotype of *macracanthus*—the most useful, including illustrations being in Bigelow and Schroeder (1957) and Compagno (1984a)—we present here proportional dimensions (Table 1) and further illustrations (Fig. 5). These data show that *macracanthus* is very similar to both *plunketi* and *ichiharai*, differing from *plunketi*

in having more prominent dorsal fin spines and slightly larger dorsal fins when compared with specimens of about the same size (Table 1), and from *ichiharai* in higher vertebral numbers (85 vs 76 precaudal; 27 vs 26 caudal; 66 vs 57 monospondylous), less erect lower teeth, smaller gill-openings and a shorter prenarial length (Table 1 and data from Yano and Tanaka, 1984). However, until more material of *macracanthus* becomes available we cannot assess the importance of these differences.

Scymnodon ichiharai: This recently described Japanese species is very similar to the New Zealand *plunketi*. Yano and Tanaka (1984) distinguished it from *plunketi* on its dermal den-

Table 3. Some proportional dimensions of *Scymnodon ichiharai* and *S. plunketi*

<i>ichiharai</i> *		<i>plunketi</i> **	
8 males, 492–1011 mmTL 6 females, 1230–1455 mmTL		4 males, 660–1197 mmTL 5 females, 523–1417 mmTL	
Juvenile n=1 492 mmLL	Adult n=13 892–1455 mmTL range (mean)	Juvenile n=2 523–660 mmTL range (mean)	Adult n=7 968–1417 mmTL range (mean)
Snout tip to (as % total length):			
outer nostrils	2.1	1.4–2.8 (1.7)	0.8–1.3 (1.1)
eye	5.3	3.6–5.6 (4.6)	3.8–4.2 (4.0)
spiracle	12.2	9.8–12.2 (11.0)	11.1–11.2 (11.2)
mouth	6.7	5.4–7.7 (6.6)	7.5–7.6 (7.6)
pectoral origin	22.0	19.0–23.6 (21.0)	19.0–19.2 (19.1)
Length of upper caudal lobe (as % total length)	22.4	17.2–19.8 (18.3)	22.7–23.8 (23.3)
Interspace between pelvic base and lower caudal fin origin as % snout tip to upper caudal fin origin (=body length of Yano and Tanaka)		10.2–14.0 (12.7)	12.0–17.7 (14.5)

* Data from Yano and Tanaka (1984).

** Data from Yano and Tanaka (1984), from specimens listed in Garrick (1959c), and from Table 1. of present account.

ticles, on some proportional dimensions (shorter pelvic-caudal interspace, longer snout and head proportions, shorter upper caudal lobe), on its larger fin spine, and on its steeper posterior 1st dorsal fin margin. We have scrutinised these distinguishing features, in some cases using additional data of *plunketi* for comparison, and reach the conclusion that although our results support those of Yano and Tanaka (1984), the cited differences between the species are slight. Almost without exception there is overlap between the two species, such that many identifications using these features would be difficult if the locality of the specimens was not known. As examples we point to the dermal denticles where seemingly only larger adult specimens may be distinguishable, or to the dorsal fin spine(s) which although described as larger than in *plunketi*, nevertheless decrease in size with growth of the body and in the case of the second dorsal are hidden by skin in some large adults (Yano and Tanaka, 1984). We also give data (Table 3) on those proportional dimensions supposedly separating the two species, to illustrate the small differences between the species and the extent of overlap. For those dimensions known to be subject to allometric growth variation we have subdivided the samples

into two size-classes (juveniles and adults). Other features which may be better indicators of differences between *ichiharai* and *plunketi* are that the former has the lower teeth more erect, and fewer vertebrae (76 vs 86–87 precaudal; 26 vs 32 caudal; 57 vs 63–65 monospondylous).

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Literature cited

Archey, G. 1921. A new species of shark. *Trans. N.Z. Inst.*, 53: 195-196, pl. 39.

Bass, A. J., J. D. D'Aubrey and N. Kistnasamy. 1976. Sharks of the east coast of southern Africa. VI. The families Oxynotidae, Squalidae, Dalatiidae and Echinorhinidae. *Invest. Rep. Oceanogr. Res. Inst. South Africa*, (45): 1-103, pls. 1-11.

Bigelow, H. B. and W. C. Schroeder. 1948. Fishes of the western North Atlantic. Part 1. Sharks. *Mem. Sears Found. Mar. Res.*, 1(1): 59-546.

Bigelow, H. B. and W. C. Schroeder. 1953. New and little known sharks from the Atlantic and from the Gulf of Mexico. *Bull. Mus. Comp. Zool.*, 109(3): 213-276.

Bigelow, H. B. and W. C. Schroeder. 1957. A study of the sharks of the suborders Squaloidea. *Bull. Mus. Comp. Zool.*, 117(1): 1-150, pls. 1-4.

Bocage, J. V. B. du and F. de B. Capello. 1864. Sur quelques espèces inédites de Squalidae. *Proc. Zool. Soc. London*, 1864: 260-263.

Cadenat, J. and J. Blache. 1981. Requins de Méditerranée et d'Atlantique (plus particulièrement de la Côte Occidentale d'Afrique). Faune tropicale No. 21. Éditions de O. R. S. T. O. M., 330 pp.

Chu, Y., C. Meng, A. Hu and S. Li. 1982. Five new species of elasmobranchiate fishes from the deep waters of South China Sea. *Oceanol. Limnol. Sinica*, 13(4): 301-311. (In Chinese with English summary.)

Compagno, L. J. V. 1973. Interrelationships of living elasmobranchs. Pages 15-61, pls. 1-2 in P. H. Greenwood, R. S. Miles and C. Patterson, eds. *Interrelationships of fishes*. *Zool. J. Linn. Soc.* 53, Suppl. 1.

Compagno, L. J. V. 1984a. FAO species catalogue. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 1 Hexanchiformes to Lamniformes. FAO Fish. Synop. (125), 4(1): 1-249.

Compagno, L. J. V. 1984b. FAO species catalogue. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 2. Carcharhiniformes. FAO Fish. Synop. (125), 4(2): 251-655.

Dolganov, V. N. 1984. A new shark from the family Squalidae caught on the Naska submarine ridge. *Zool. J.*, 63(10): 1589-1591. (In Russian with English summary.)

Garman, S. 1906. New Plagiostomia. *Bull. Mus. Comp. Zool.*, 46(11): 203-208.

Garrick, J. A. F. 1955. Studies on New Zealand Elasmobranchii. Part IV. The systematic position of *Centroscymnus waitei* (Thompson, 1930), Selachii. *Trans. Roy. Soc. N.Z.*, 83(1): 227-239.

Garrick, J. A. F. 1956. Studies on New Zealand Elasmobranchii. Part V. *Scymnodalatias* n.g. based on *Scymnodon sherwoodi* Archey, 1921 (Selachii). *Trans. Roy. Soc. N.Z.*, 83(3): 555-571.

Garrick, J. A. F. 1959a. Studies on New Zealand Elasmobranchii. Part VII. The identity of specimens of *Centrophorus* from New Zealand. *Trans. Roy. Soc. N.Z.*, 86(1): 127-141.

Garrick, J. A. F. 1959b. Studies on New Zealand Elasmobranchii. Part VIII. Two northern hemisphere species of *Centroscymnus* in New Zealand waters. *Trans. Roy. Soc. N.Z.*, 87(1/2): 75-89.

Garrick, J. A. F. 1959c. Studies on New Zealand Elasmobranchii. Part IX. *Scymnodon plunketi* (Waite, 1910), an abundant deep-water shark of New Zealand waters. *Trans. Roy. Soc. N.Z.*, 87(3/4): 271-282.

Garrick, J. A. F. 1960a. Studies on New Zealand Elasmobranchii. Part XI. Squaloids of the genera *Deania*, *Etmopterus*, *Oxynotus* and *Dalatias* in New Zealand waters. *Trans. Roy. Soc. N.Z.*, 88(3): 489-517, pl. 1.

Garrick, J. A. F. 1960b. Studies on New Zealand Elasmobranchii. Part XII. The species of *Squalus* from New Zealand and Australia; and a general account and key to the New Zealand Squaloidea. *Trans. Roy. Soc. N.Z.*, 88(3): 519-557.

Garrick, J. A. F. 1982. Sharks of the genus *Carcharhinus*. NOAA Tech. Rep., 445: 1-194.

Günther, A. 1877. Preliminary notes on new fishes collected in Japan during the voyage of H.M.S. Challenger. *Ann. Mag. Nat. Hist.*, (4), 20: 433-446.

Hubbs, C. L., T. Iwai and K. Matsubara. 1967. External and internal characters, horizontal and vertical distribution, luminescence, and the food of the dwarf pelagic shark, *Euprotomicrus bispinatus*. *Bull. Scripps Inst. Oceanogr.*, 10: i-vi+1-64., pls 1-8.

Hubbs, C. L. and J. L. McHugh. 1951. Relationships of the pelagic shark *Euprotomicrus bispinatus*, with description of a specimen from off California. *Proc. Calif. Acad. Sci.*, 4th ser., 27(6): 159-176, pls 1-3.

Jordan, D. S. and H. W. Fowler. 1903. A review of the elasmobranchiate fishes of Japan. *Proc. U.S. Natn. Mus.*, 26(1324): 593-674, pl. 26.

Krefft, G. 1980. Results of the research cruises of FRV "Walther Herwig" to South America. LIII. Sharks from the pelagic trawl catches obtained during Atlantic transects, including some specimens from other cruises. *Arch. Fischereiwiss.*, 30(1): 1-16.

Lönnberg, E. 1907. Fische. *In Ergebnisse Ham-*

burger Megalhaenische Sammelreise, Hamburg, 8(6): 1-16, pl. 1. (not seen).

Maisey, J. G. 1975. The interrelationships of phalacanthous selachians. Neu. Jähr. Geol. Palaontol. Monat., 9: 553-567.

Maurin, C. and M. Bonnet. 1970. Poissons des côtes nord-ouest africaines (Campagnes de la "Thalassa" 1962 et 1968). Rev. Trav. Inst. Pech. Mar., 34: 125-170.

Nakaya, K. 1982. Squalidae. Pages 44-53, 310-314 in O. Okamura, K. Amaoka and F. Mitani, eds. Fishes of the Kyushu-Palau Ridge and Tosa Bay. Japan Fish. Resource Conserv. Ass., Tokyo.

Nakaya, K. 1984. Squalidae. Pages 50-59, 300-304 in O. Okamura, and T. Kitajima, eds. Fishes of the Okinawa Trough and the adjacent waters. I. Japan Fish. Resource Conserv. Ass., Tokyo.

Parin, N. V., G. A. Golovan, N. P. Pakhorukov, Y. I. Sasonov and Y. N. Shcherbachov. 1981. Fishes from the Nazca and Sala-y-Gomez underwater ridges collected in cruise of R/V "Ikhtiandr". Pages 5-18 in N. V. Parin, ed. Fishes of the open ocean. Inst. Oceanol., Acad. Sci. USSR, Moscow.

Regan, C. T. 1906. Description of some new sharks in the British Museum Collection. Ann. Mag. Nat. Hist., (7), 18: 435-440.

Shirai, S. 1983. Squalidae. Pages 47-51, 164-166 in K. Amaoka, K. Nakaya, H. Araya and T. Yasui, eds. Fishes from the northeastern Sea of Japan and the Okhotsk Sea off Hokkaido. Japan Fish. Resource Conserv. Ass., Tokyo.

Uyeno, T. and K. Sasaki. 1983. Squalidae. Pages 61-66 in T. Uyeno, K. Matsuura and E. Fujii, eds. Fishes trawled off Suriname and French Guiana. Japan Mar. Fish. Resource Res. Cent., Tokyo.

Vaillant, L. 1888. Expéditions scientifiques du Travailleur et du Talisman pendant des années 1880, 1881, 1882, 1883. Poissons. G. Masson, Paris, 406 pp., 28 pls.

Waite, E. R. 1910. Notes on New Zealand fishes. Trans. N.Z. Inst., 42: 384-391, pls. 35-38.

Yano, K. and S. Tanaka. 1983. Portuguese shark, *Centroscymnus coelolepis* from Japan, with notes on *C. owstoni*. Japan. J. Ichthyol., 30(3): 208-216.

Yano, K. and S. Tanaka. 1984. Review of the deep sea squaloid shark genus *Scymnodon* of Japan, with a description of a new species. Japan. J. Ichthyol., 30(4): 341-360.

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Addendum

We presume that the southeastern pacific specimen reported as *Scymnodalatius* sp. by Parin *et al.* (1981) is the same specimen which Dolganov (1984) later described and designated as holotype, and only known representative, of a new species in a new genus, *Mollisquama parini*, which he thought to be closest to *Scymnodalatius* and *Isistius*. The account of *M. parini* came to our attention too late for us to incorporate it in our discussion of *Scymnodalatius*, but it is clear from Dolganov's description and illustrations that *Mollisquama* and *Scymnodalatius* are not only similar in external form but also share other important common features including: a lack of dorsal fin spines; dermal denticles with transverse microsculpture; comparably shaped teeth; and very similar vertebral numbers. However, there are major differences between these two genera, and *Mollisquama* appears to be unique amongst sharks in, on the one hand, possessing large glandular structures with prominent slit-like apertures along the posterior half of the pectoral fin bases, and on the other hand, lacking upper labial furrows. Further differences between these genera, as noted by Dolganov, are that in *Mollisquama* the first dorsal fin is placed more rearwards such that its posterior tip is above the pelvic fin origin, there are many fewer teeth ($\frac{25}{31}$ versus $\frac{57 \text{ to } 62}{34 \text{ or } 35}$), and the dermal denticles are leaf-shaped with only a single posterior point rather than tridentate. We note also that in *Mollisquama* the tips of the pectoral fins and the upper lobe of the caudal fin are rounded instead of attenuate and pointed as in *Scymnodalatius*.

南半球高緯度海域から採集された *Scymnodalatius* 属の
1 新種と近縁のツノザメ科魚類

谷内 透・J. A. F. Garrick

南半球高緯度海域から得られた 2 個体の標本に基づいてツノザメ科の新種 *Scymnodalatius albicauda* が記載された。本種は同属の *S. sherwoodi* から、尾鰭に幅広い白紋があること、第 2 背鰭後葉が尾鰭上葉起部にほとんど達すること、吻と頭が短いこと、眼が小さいこと、各鰭が大きいことで区別される。また、*Scymnodalatius* 属と近縁な *Scymnodon*, *Centroscymnus*, *Zameus* の 3 属との関係が主に皮膚の構造に基づいて論議された。さらに、上述の属および本種と類縁の深い数種について相互の関係を検討したところ、*Scymnodon* 属には *ichiharai*, *macracanthus*, *plunketi*, *ringens* を *Centroscymnus* 属には *coelolepis*, *crepidater*, *cryptacanthus*, *owstonii* を、*Zameus* 属には *squamulosus* を含めることを提唱した。

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